

LISTING OF THE CLAIMS

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Claim 1. (currently amended) A precursor source mixture utilized for chemical vapor deposition or atomic layer deposition comprising at least one precursor compound which is dissolved, emulsified or suspended in an inert liquid, where said precursor compound is a precursor metal atom bound to a ligand selected from the group consisting of hydride, carbonyl, imido, hydrazido, phosphido, nitrosyl, nitryl, nitrate, nitrile, halide, azide, siloxy, silyl, ~~with the proviso that the compound is not trimethyl amine alane.~~ with the proviso that the precursor compound is not an alkylamine alane, MeAu(PMe₃), or (Me₃P)Cu(tertbutoxy), and the proviso that the precursor metal atom is not Pt.

Claim 2. (previously amended) The precursor source mixture of Claim 1 wherein said inert liquid is an aliphatic hydrocarbon, aromatic hydrocarbon, alcohol, ether, aldehyde, ketone, acid, phenol, ester, alkylnitrile, halogenated hydrocarbon, silyated hydrocarbon, thioether, amine, cyanate, isocyanate, thiocyanate, silicone oil, nitroalkyl, alkylnitrate, or mixtures thereof.

Claim 3. (previously cancelled)

Claims 4 – 12. (previously withdrawn)

Claim 13. (previously cancelled)

c/ Claim 14. (original) The precursor source mixture of Claim 1 wherein said inert liquid vaporizes at a higher temperature than said at least one precursor compound.

Claim 15. (original) The precursor source mixture of Claim 2 wherein said inert liquid is a C₅₋₁₂ alkane.

Claim 16. (original) The precursor source mixture of Claim 1 wherein said inert liquid contains an additive of no more than 30% by volume of the inert liquid.

Claim 17. (original) The precursor source mixture of Claim 16 wherein said additive is an additional precursor ligand, an additional precursor adduct, or other coordinating compound selected from the group consisting of phosphines, phosphites, aryls, amines, arsines, stibenes, ethers, sulfides, nitriles, isonitriles, alkenes, pyridines, heterocycles, tetrahydrofuran, dimethylformamide, macrocycles, schiff bases, cycloalkenes, alcohols, phosphine oxides and alkynes.

Claim 18. (previously amended) The precursor source mixture of Claim 16 wherein the additive is selected from the group consisting of methanol, ethanol, isopropanol, neopentanol, trimethylamine, dimethylethylamine, diethylmethylamine, triethylamine, dimethylamine, diethylamine, bistrimethylsilylamine, ammonia, ethylenediamine, propylenediamine, trimethylethylenediamine, triphenylphosphine, triethylphosphine, trimethylphosphine, allyl, cyclopentadiene, benzene, ethylbenzene, toluene, cyclohexadiene, cyclooctadiene, cycloheptatriene, cyclooctatetraene, mesitylene, tetrahydrofuran, dimethylformamide,

c/ dimethylsulfoxide, butyl acetate, acetic acid, ethylhexanoic acid, methane, ethane, pyridine, and PF₃.

Claim 19. (original) The precursor source mixture of Claim 1 wherein the inert liquid is composed of two or more components selected from the group consisting of aliphatic hydrocarbons, aromatic hydrocarbons, alcohols, ethers, aldehydes, ketones, acids, phenols, esters, amines, alkylnitrile, halogenated hydrocarbons, silyated hydrocarbons, thioethers, amines, cyanates, isocyanates, thiocyanates, silicone oils, nitroalkyl, alkylnitrate, and/or mixtures of one or more of the above and an additive of no more than 30% by volume of the inert liquid wherein the additive is selected from the group consisting of additional precursor ligand, additional precursor adduct, and other coordinating compound selected from the group consisting of phosphines, phosphites, aryls, amines, arsines, stibenes, ethers, sulfides, nitriles, isonitriles, alkenes, pyridines, heterocycles, tetrahydrofuran, dimethylformamide, macrocycles, schiff bases, cycloalkenes, alcohols, phosphine oxides, and alkynes.

Claim 20. (previously amended) The precursor source mixture of Claim 19 wherein the additive is selected from the group consisting of methanol, ethanol, isopropanol, neopentanol, trimethylamine, dimethylethylamine, diethylmethylamine, triethylamine, dimethylamine, diethylamine, bistrimethylsilylamine, ammonia, ethylenediamine, propylenediamine, trimethylethylethylenediamine, triphenylphosphine, triethylphosphine, trimethylphosphine, allyl, cyclopentadiene, benzene, ethylbenzene, toluene, cyclohexadiene, cyclooctadiene, cycloheptatriene, cyclooctatetraene, mesitylene, tetrahydrofuran, dimethylformamide,

dimethylsulfoxide, butyl acetate, acetic acid, ethylhexanoic acid, methane, ethane, pyridine, and PF₃.

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Claim 21. (original) The precursor source mixture of Claim 1 wherein the inert liquid is composed of C₅-C₁₂ alkane and contains an additive of no more than 30% by volume of the inert liquid wherein the additive is selected from the group consisting of an additional precursor ligand, an additional precursor adduct, or other coordinating compound selected from the group consisting of phosphines, phosphites, aryls, amines, arsines, stibenes, ethers, sulfides, nitriles, isonitriles, alkenes, pyridines, heterocycles, tetrahydrofuran, dimethylformamide, macrocycles, schiff bases, cycloalkenes, alcohols, phosphine oxides, and alkynes.

Claim 22. (previously amended) The precursor source mixture of Claim 21 wherein the additive is methanol, ethanol, isopropanol, neopentanol, trimethylamine, dimethylethylamine, diethylmethylamine, triethylamine, dimethylamine, diethylamine, bistrimethylsilylamine, ammonia, ethylenediamine, propylenediamine, trimethylethylethylenediamine, triphenylphosphine, triethylphosphine, trimethylphosphine, allyl, cyclopentadiene, benzene, ethylbenzene, toluene, cyclohexadiene, cyclooctadiene, cycloheptatriene, cyclooctatetraene, mesitylene, tetrahydrofuran, dimethylformamide, dimethylsulfoxide, butyl acetate, acetic acid, ethylhexanoic acid, methane, ethane, pyridine, or PF₃.

Claim 23. (previously cancelled)

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Claim 24. (original) A method for chemical vapor deposition or atomic layer deposition comprising: vaporizing the precursor compound in the precursor source mixture of Claim 1, introducing the vaporized precursor into a chemical vapor deposition or atomic layer deposition reactor with optional addition of other co-reactant(s), and depositing a constituent of the vaporized precursor on a substrate to form a film.

Claim 25. (original) The method of Claim 24 wherein said film is a component in an electronic device.

Claim 26. (original) The method of Claim 24 wherein said co-reactant(s) is introduced separately from said vaporized precursor.

Claim 27. (original) The method of Claim 24 comprising vaporizing the precursor in the precursor source mixture, and introducing the vaporized precursor into an atomic layer deposition reactor with separate addition of other co-reactant(s) and inert purge gas and depositing a film on a substrate by sequential introduction of alternating pulses of vaporized precursor(s), purge gas, co-reactant(s) and purge gas.

Claim 28. (original) The method of Claim 24 wherein the co-reactant is a reducing agent, an oxidizing agent, a nitriding agent or a silyating agent.

Claim 29. (previously amended) The method of Claim 28 wherein said co-reactant is a reducing agent selected from the group consisting of hydrogen, forming gas, silane, and combinations thereof.

Claim 30. (previously amended) The method of Claim 28 wherein said co-reactant is an oxidizing agent selected from the group consisting of oxygen, ozone, water, hydrogen peroxide, nitrous oxide, and combinations thereof.

Claim 31. (previously amended) The method of Claim 28 wherein said co-reactant is a nitriding agent selected from the group consisting of ammonia, hydrazine, hydrogen azide, tertbutylamine, isopropylamine, and combinations thereof.

Claim 32. (previously amended) The method of Claim 28 wherein said co-reactant is a silyating agent selected from the group consisting of silane, disilanes, chlorosilanes, silylamines, silazanes, and combinations thereof.

Claim 33. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of three or more different gases wherein one of said gases comprises vaporized precursor of said precursor source mixture, another of said gases is a purge gas and another of said gases is a reducing agent.

Claim 34. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of three or more different gases wherein one of said gases

c/ comprising said vaporized precursor of said precursor source mixture, another of said gases is a purge gas and another of said gases is a nitriding agent.

Claim 35. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of four or more different gases, wherein one of said gases comprises said vaporized precursor of said precursor source mixture, another of said gases is a purge gas, another of said gases is an oxidizing agent and another of said gases is selected from the group consisting of any vaporized precursor and a vaporized precursor of a precursor source mixture according to Claim 1.

Claim 36. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of four or more different gases, wherein one of said gases comprises vaporized precursor of said precursor source mixture, another of said gases is a purge gas, another of said gases is a nitriding agent and another of said gases is selected from the group consisting of any vaporized precursor and a vaporized precursor of a precursor source mixture according to Claim 1.

Claim 37. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of four or more different gases, wherein one of said gases comprises vaporized precursor of said precursor source mixture, another of said gases is a purge gas, another of said gases is a reducing agent and another of said gases is selected from the group consisting of any vaporized precursor and a vaporized precursor of a precursor source mixture according to Claim 1.

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Claim 38. (original) The method of Claim 24 comprising subjecting said substrate to a sequence of alternating pulses of five or more different gases, wherein one of said gases comprises vaporized precursor of said precursor source mixture, another of said gases is a purge gas, another of said gases is a reducing agent and another of said gases is selected from the group consisting of any Si containing vaporized precursor and a Si containing vaporized precursor of a precursor source mixture according to

Claim 1.

Claim 39. (original) The method of Claim 24 wherein the substrate is selected from the group consisting of semiconductor substrates, dielectrics, metals, organic substrates, glasses, metal oxides, and plastic polymeric substrates, Si-containing semiconductor substrates, ceramics, silicon-on-insulator substrates, Ge substrates, SiGe substrates, GaAs substrates, and mixtures or multilayers thereof.

Claim 40. (original) The method of Claim 25 wherein said electronic device is a transistor, capacitor, diode, resistor, switch, light emitting diode, laser, wiring structure, or interconnect structure.

Claim 41. (original) A method of fabricating a stack or trench capacitor structure composed of a bottom electrode, a dielectric layer, a top electrode layer and an optional dielectric buffer layer over said capacitor which is connected to underlying circuitry via a plug and optional

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barrier wherein at least one component of the capacitor structure is deposited according to Claim 24.

Claim 42. (original) The method of Claim 41 wherein the optional dielectric barrier is selected from the group consisting of SiO₂, SiO_xN_y, Si₃N₄, TiON, AlN, SiN, TiN, Ta₂O₅, TiO₂, ZrO₂, HfO₂, Al₂O₃, La₂O₃, Y₂O₃, alloys, mixtures or layers thereof, and multicomponent metal oxides.

Claim 43. (original) The method of Claim 41 wherein the dielectric is a ferroelectric material.

Claim 44. (original) The method of Claim 41 wherein the plug material is selected from the group consisting of polysilicon, W, Mo, Ti, Cr, Cu, and doped or undoped alloys, mixtures and multilayers thereof.

Claim 45. (previously amended) The method of Claim 41 wherein the conductive barrier is selected from the group consisting of TaN, TaSiN, TiAlN, TiSiN, TaWN, TiWN, NbN, ZrN, TaTiN, IrOx, Os, OsOx, MoSi, TiSi, ReO₂, and doped or undoped alloys, mixtures and multilayers thereof.

Claim 46. (original) The method of Claim 41 wherein the bottom electrode is selected from the group consisting of conductive materials, polysilicon, Ni, Pd, Pt, Cu, Ag, Au, Ru, Ir, Rh, OrOx, TaN, TaSiN, Ta, SrRuO₃, LaSrCoO₃, and doped or undoped alloys, mixtures and multilayers thereof.

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Claim 47. (original) The method of Claim 41 wherein the dielectric material is selected from the group consisting of SiO_2 , SiO_xN_y , Si_3N_4 , Ta_2O_5 , TiO_2 , ZrO_2 , HfO_2 , Al_2O_3 , La_2O_3 , Y_2O_3 , multicomponent metal oxides, perovskite type oxide having the formula ABO_3 wherein B is at least one acid oxide containing a metal selected from the group consisting of Al, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W and Cu, and A is at least one additional cation having a positive formal charge of from about 1 to about 3, barium strontium titanate, barium strontium zirconate, barium strontium hafnate, lead titanate, yttrium aluminate, lanthanum aluminate, lead zirconium titanate, strontium bismuth tantalate, strontium bismuth niobate, bismuth titanate, lanthanum silicate, yttrium silicate, hafnium silicate, zirconium silicate, rare earth doped silicates and doped or undoped alloys, mixtures and multilayers thereof.

Claim 48. (original) The method of Claim 41 wherein the top electrode is selected from the group consisting of polysilicon, Ni, Pd, Pt, Cu, Ag, Au, Ru, Ir, Rh, IrO_x , TaN, TaSiN, Ta, SrRuO_3 , LaSrCoO_3 , and doped or undoped alloys, mixtures and multilayers thereof.

Claim 49. (original) A method of fabricating a wiring structure composed of etched trenches and vias into a dielectric layer, optional barrier material between dielectric and wiring material, and wiring material wherein at least one component of the wiring structure is deposited according to Claim 24.

Claim 50. (original) The method of Claim 49 wherein the dielectric layer is selected from the group consisting of SiO₂, SiO_xN_y, Si₃N₄, phosphosilicate glass, metal oxides, Al₂O₃ and doped or undoped alloys, mixtures and multilayers thereof.

Claim 51. (original) The method of Claim 49 wherein the optional barrier material is selected from the group consisting of WN, TiN, TaN, SiO₂, SiO_xN_y, Si₃N₄, phosphosilicate glass, metal oxides, Al₂O₃, and doped or undoped alloys, mixtures and multilayers thereof.

Claim 52. (original) The method of Claim 49 wherein the wiring material is selected from the group consisting of polysilicon, Al, W, Mo, Ti, Cr, Cu and doped or undoped alloys, mixtures and multilayers thereof.

Claim 53. (original) A method of fabricating an electronic device composed of a substrate having source and drain regions and a channel region between said source and drain regions, a gate dielectric, aligned to and on top of said channel region, and a gate electrode aligned to and on top of said gate dielectric wherein at least one component of the electronic device is deposited according to Claim 24.

Claim 54. (currently amended) A method of Claim 53 wherein the gate dielectric selected from the ~~group~~ group consisting of SiO₂, SiO_xN_y, Si₃N₄, Ta₂O₅, TiO₂, ZrO₂, HfO₂, Al₂O₃, La₂O₃, Y₂O₃, multicomponent metal oxides, perovskite type oxide having the formula ABO₃ wherein B is at least one acid oxide containing a metal selected from the group consisting of Al, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W and Cu, and A is at least one additional cation having a

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positive formal charge of from about 1 to about 3, barium strontium titanate, barium strontium zirconate, barium strontium hafnate, lead titanate, yttrium aluminate, lanthanum aluminate, lead zirconium titanate, strontium bismuth tantalate, strontium bismuth niobate, bismuth titanate, lanthanum silicate, yttrium silicate, hafnium silicate, zirconium silicate, rare earth doped silicates and doped or undoped alloys, mixtures and multilayers thereof.

Claim 55. (original) The method of Claim 53 wherein gate dielectric is composed of more than one layer.

Claim 56. (original) The method of Claim 53 wherein the gate electrode is selected from the group consisting of polysilicon, Al, Ag, Bi, Cd, Fe, Ga, Hf, In, Mn, Nb, Y, Zr, Ni, Pt, Be, Ir, Te, Re, Rh, W, Mo, Cr, Fe, Pd, Au, Rh, Ti, Cr, Cu, and doped or undoped alloys, mixtures and multilayers thereof.

Claim 57. (currently amended) The precursor source mixture of Claim 1 wherein the at least one precursor compound is $\text{Me}_2\text{AlH}(\text{NEtMe}_2)$; $(\text{EtMe}_2\text{N})\text{AlH}_3$; $(\text{Et}_3\text{N})\text{AlH}_3$; B, Al, Ga, In, As or Sb, hydride, chloride, fluoride, bromide, iodide, Cp or azide; trimethylamine; diethylmethylaniline, dimethylethylaniline, or triethylaniline; $\text{Mo}(\text{CO})_3$; $\text{Ru}_3\text{CO}_{12}$; $\text{Fe}(\text{CO})_5$; $\text{Co}_2(\text{CO})_8$; $\text{Os}_3\text{CO}_{12}$; $\text{Cr}(\text{CO})_6$; $\text{Mn}_2(\text{CO})_{10}$; $\text{Mo}(\text{CO})_6$; $\text{Ni}(\text{CO})_4$; $\text{Re}_2(\text{CO})_{10}$; $\text{Ru}_3(\text{CO})_{12}$; $\text{W}(\text{CO})_6$; $\text{CF}_3\text{Co}(\text{CO})_4$; $(\text{CO})_4\text{Fe}[\text{P}(\text{OCH}_3)_3]$; $(\text{CO})_4\text{Fe}[\text{N}(\text{CH}_3)_3]$; $\text{CoNO}(\text{CO})_3$; $\text{OSi}(\text{CH}_3)_3$ Li, Na, K, Rb, Cs, Fr, Cu, Ag, Au, Hg, or Tl; tetra- $\text{OSi}(\text{CH}_3)_3$ Si, Ge, Sn, Pb, Ti, Zr, or Hf; tri- $\text{OSi}(\text{CH}_3)_3$, B, Al, Ga, In, P, As, or Sb; tetrakis(dimethylamino), tetrakis(diethylamino) Ti, Zr, Hf, Si, Ge, Sn, or

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~~Pb~~; diethylaminoarsine dichloride; bisdimethylaminoarsine chloride;
 tris(dimethylamino) phosphine; tris(dimethylamino) antimony;
 tris(dimethylamino) arsine; tris(dimethylamino) stibine;
 bis(dimethylamino)(trimethylethylenediamine) aluminium;
 (CO)₄Fe[N(CH₃)₃], Li, Na, or K N(SiMe₃), pentadimethylaminotantalum;
 diethylaminodimethyltin; hexadimethylaminoditungsten;
 trisdimethylamino(trimethylethylenediamine)titanium; CpCu(PEt₃);
 CpCu(triphenylphosphine); ~~Pt~~(PF₃)₄; Ni(PF₃)₄; Cr(PF₃)₆; (Et₃P)₃Mo(CO)₃;
 Ir(PF₃)₄; Ti(NO₃)₄; Zr(NO₃)₄; Hf(NO₃)₄; Si(CH₃)₃(NO₃); RuNO(NO₃)₃; gallium
 nitrate; Sn(NO₃)₄; Co(NO₃)₃; VO(NO₃)₃; CrO₂(NO₃)₂; TiCl₄; ZnCl₂; ZrCl₄;
 HfCl₄; AlCl₃; SiCl₄; GaCl₃; SnCl₄; CoCl₃; N(SiMe₃) Li, Na, or K;
 B(CH₂SiMe₃)₃; ~~{(Me₃Si)₂N}₃-B, Al, Ga or In; (Me₃SiCH₂)₄ Ti, Zr or Hf; or~~
~~{(Me₃Si)₂N}₂-Zn, Cd or Hg.~~
